1047.C.3

Industrial Exposure and Control Technologies for OSHA Regulated Hazardous Substances

U.S. Department of Labor
Elizabeth Dole, Secretary
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Volume I of II
Substances A-I

Occupational Safety and Health Administration
John A. Pendergrass, Assistant Secretary

Chlorine
(CAS NUMBER: 7782-50-5)

SYNONYMS

Chlorine mol/Chlorine molecule /Diatomic chlorine/Dichlorine/ Molecular chlorine/Bertholite/Chloor (Dutch)/Chlor (German)/ Chlore (French)/Cloro (Italian)

TRADE NAMES

NONE

DESCRIPTION OF SUBSTANCE

Chlorine is a greenish yellow gas with a pungent suffocating odor. It is slightly soluble in water. It reacts explosively or forms explosive compounds with many common chemicals. [(C)AAR, 1986]

HEALTH EFFECTS

Chlorine reacts with body moisture to form acids. It is itself extremely irritating to skin, eyes, and mucous membranes, and it may cause corrosion of teeth. Prolonged exposure to low concentrations may produce chloracne. Chlorine in high concentrations acts as an asphyxiant by causing cramps in the muscles of the larynx (choking), swelling of the mucous membranes, nausea, vomiting, anxiety, and syncope. Acute respiratory distress including cough, hemoptysis, chest pain, dyspnea, and cyanosis develop, and later tracheobronchitis, pulmonary edema, and pneumonia may supervene. [SITTIG, P. 217-218, 1985]
Medical conditions generally aggravated by exposure: bronchitis or chronic lung conditions. [EPA, 1986]
Exposures to 3-6 ppm cause stinging or burning sensation in eyes, nose and throat, headache, redness and watering of eyes, sneezing, coughing, and huskiness or loss of voice. Bleeding of nose may also occur; sputum from pharynx and trachea may be blood-tinged. [PATTY. INDUS HYG & TOX 2ND ED VOL2 1963]
Concentrations of 0.8-1 ppm cause permanent, although moderate, reduction in pulmonary function. [ENCYC OCCUPAT HEALTH & SAFETY 1983]
Men exposed in bleaching rooms to concentration of the order of (5 ppm) age prematurely, suffer from disease of the bronchi, and become predisposed to tuberculosis. [PATTY. INDUS HYG & TOX 2ND ED VOL2 1963]
Patient had myasthenia gravis manifested by laryngeal stridor after accidental exposure to chlorine gas. Diagnosis was established by correction of abnormal pulmonary function after injection of edrophonium chloride. Patient subsequently had generalized myasthenia gravis. [FOULKS CJ; MYASTHENIA GRAVIS PRESENTING AS LARYNGEAL STRIDOR AFTER EXPOSURE TO CHLORINE GAS;

AMBIENT WATER QUALITY CRITERIA DOC: CHLORINE P.14 (1981) EPA 440/3-78-005]
Fungicidal foot baths, root canal or tooth extraction, irrigation, or wound sterilization. [USEPA; AMBIENT WATER QUALITY CRITERIA DOC: CHLORINE P.15 (1981) EPA 440/3-78-005]
Cleaning dairy equipment. [NIOSH OSHA. OCCUPAT HEALTH GUIDE CHEM HAZARDS. 1981]
Manufacture of pesticides, antifreeze, refrigerants, antiknock compounds, plastics, and resins. [NIOSH OSHA. OCCUPAT HEALTH GUIDE CHEM HAZARDS. 1981]
Odor control and demulsifier in treatment of water. [NIOSH OSHA. OCCUPAT HEALTH GUIDE CHEM HAZARDS. 1981]
Disinfectant in laundries and dishwater. [NIOSH OSHA. OCCUPAT HEALTH GUIDE CHEM HAZARDS. 1981]

NIOSH 1982 NATIONAL OCCUPATIONAL EXPOSURE SURVEY

SIC CODE	INDUSTRY NAME	TOTAL ON PAYROLL	TOTAL EXPOSED	PERCENT EXPOSED
4952	SEWERAGE SYSTEMS	119	51	42.86
4941	WATER SUPPLY	631	200	31.70
3332	PRIMARY LEAD	300	86	28.67
2812	ALKALIES AND CHLORINE	983	205	20.85
2833	MEDICINALS AND BOTANICALS	2,347	428	18.24
2022	CHEESE, NATURAL AND PROCESSED	906	165	18.21
2819	IND. INORGANIC CHEMICALS, NEC	11,107	1,807	16.27
2911	PETROLEUM REFINING	10,713	1,315	12.27
3353	ALUMINUM SHEET/PLATE/FOIL	346	40	11.56
3361	ALUMINUM FOUNDRIES	264	26	9.85
2086	BOTTLED AND CANNED SOFT DRINKS	3,695	344	9.31
2822	SYNTHETIC RUBBER	488	40	8.20
2899	CHEMICAL PREPARATIONS, NEC	1,872	122	6.52
4911	ELECTRIC SERVICES	7,193	459	6.38

NIOSH 1972 NATIONAL OCCUPATIONAL HAZARD SURVEY

SIC CODE	INDUSTRY NAME	TOTAL ON PAYROLL	TOTAL EXPOSED	PERCENT EXPOSED
6514	DWELLING OPERATORS, EXC. APAR	21	3	14.29
0715	PACKING OF FRUITS AND VEGETAB	87	12	13.79
4924	NATURAL GAS DISTRIBUTION	451	58	12.86
1711	PLUMBING, HEATING, AIR CONDIT	2,634	283	10.74
1731	ELECTRICAL WORK	3,362	340	10.11
2816	INORGANIC PIGMENTS	708	71	10.03
2015	POULTRY DRESSING PLANTS	1,128	108	9.57
7949	AMUSEMENT AND RECREATION, NEC	556	49	8.81
2818	INDUSTRIAL ORGANIC CHEMICALS	1,362	114	8.37
1799	SPECIAL TRADE CONTRACTORS, NE	1,302	85	6.53
2815	CYCLIC INTERMEDIATES AND CRUD	160	10	6.25

SOUTH MED J 74 (11): 1423-4 (1981)]

TOXICITY/EXPOSURE LIMITS

NFPA RATING - Flammability - 0 None
Health - 3 Severe
Reactivity - 0 None

TOXICITY HAZARD RATING - Acute local: irritant 3; inhalation 3. 3= High: may cause death or permanent injury after very short exposure to small quantities. [SAX. DANGER PROPS INDUS MATER 6TH ED, P. 673, 1984]

IMMEDIATELY DANGEROUS TO LIFE OR HEALTH - 30 ppm. [NIOSH; POCKET GUIDE TO CHEMICAL HAZARDS P.74 (1987) DHHHS(NIOSH) PUB NO. 85-114]

OSHA PEL - 0.500 ppm, 1.500 mg/m3;TWA
1.000 ppm, 3.000 mg/m3;STEL

ADOPTED ACGIH/TLV - 1.000 ppm, 3.000 mg/m3;TWA
3.000 ppm, 9.000 mg/m3;STEL

NIOSH/REL -
0.500 ppm, 1.5000 mg/m3;STEL - 15 minutes

INDUSTRY USE DATA

Chlorine is used in the manufacture of chlorinated lime; used in bleaching all kinds of fabric; manufacture of synthetic rubber and plastics; for purifying water; detinning and dezincing iron; disinfecting. [MERCK INDEX. 10TH ED 1983]
Chemical intermediate for vinyl chloride, for epichlorohydrin, for other chlorinated organic compoounds, for chlorinated inorganic compounds; manufacture of pulp and paper; waste treatment. [SRI]
Shrink-proofing wool; in flame-retardant compound; in special batteries (with lithium or zinc); processing of meat, fish, vegetables and fruit. [HAWLEY. CONDENSED CHEM DICTNRY 10TH ED 1981]
Manufacture of carbon tetrachloride, ethylene and propylene oxides, glycols, trichloroethylene, perchloroethylene, chloroform, vinylidene chloride, polychloroprene, hydrogen chloride, metal chlorides, chloracetic acid, chloral, synthetic glycerine, methyl chlorides, chlorinated benzenes, tetraethyl lead, fluorine compounds, titanium tetrachloride, monochloroacetic acid, phosgene, chloroisocyanuric acid, phosphorus chloride, dichlorobutene, and chlorinated paraffins. [USEPA; AMBIENT WATER QUALITY CRITERIA DOC: CHLORINE P.12 (1981) EPA 440/3-78-005]
Agent used to control biofouling in cooling systems. [USEPA;

2819	INDUSTRIAL INORGANIC CHEMICAL	2,679	163	6.08
2083	MALT	37	2	5.41
4941	WATER SUPPLY	115	6	5.22
5081	COMMERCIAL MACHINES AND EQUIP	822	42	5.11
3361	ALUMINUM CASTINGS	827	42	5.08

OSHA/EXPOSURE DATA

NONE

ENGINEERING CONTROLS

General ventilation; local exhaust ventilation; hood; enclosure of process or worker. These are methods for chlorine gas overexposure from a chloralkali plant. Company operation was primary aluminum smelter; production of chlorine gas from brine water using mercury cell process. Increase diameter of brine header to accommodate gas phase above liquid phase. Eliminate pressure drop. Increase the number of cells in system. Adjust brine pH. Modify compressor controls to accommodate surges in pressure. Replace inlet box covers with ABS covers. Modify brine feed nozzle flange. [HAZARD ABATEMENT FILE]

PERSONAL PROTECTIVE EQUIPMENT

Employees should be provided and required to use impervious clothing, gloves, face shields (8-inch minimum), and other appropriate protective clothing necessary to prevent skin contact with liquid chlorine, and to prevent skin from becoming frozen from contact with vessels containing liquid chlorine. [NIOSH OSHA. OCCUPAT HEALTH GUIDE CHEM HAZARDS. 1981]
Respiratory protective equipment of a type approved by MSHA and NIOSH for chlorine (Cl2) service should always be readily available in places where this substance is used and so located as to be easily reached in case of need. [NRC. HNDLING HAZARD CHEM 1981]
Wear chemical goggles. [ITI. TOX & HAZARD INDUS CHEM SAFETY MANUAL 1982]
Respiratory protection should be as follows: Up to 5 ppm: any chemical cartridge respirator with cartridge(s) providing protection against the compound of concern; or any supplied-air respirator or self-contained breathing apparatus. Substance reported to cause eye irritation or damage; may require eye protection. Up to 12.5 ppm: any supplied-air respirator operated in a continuous flow mode; or any powered air-purifying respirator with cartridge(s) providing protection against the compound of concern. Substance reported to cause eye irritation or damage; may require eye protection. Up to 25 ppm: any self-contained breathing apparatus with a full facepiece or any supplied-air respirator with a full facepiece; any chemical cartridge respirator with a full facepiece and cartridge(s) providing protection against the compound of concern; any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted canister providing protection against the compound of concern; or any powered

air-purifying respirator with a tight-fitting facepiece and cartridge(s) providing protection against the compound of concern. Substance reported to cause eye irritation or damage; may require eye protection. Emergency or planned entry in unknown concentration or IDLH conditions: any self-contained breathing apparatus with full facepiece and operated in a pressure-demand or other positive pressure mode or any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus and operated in pressure-demand or other positive pressure mode. Escape: any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted canister providing protection against the compound of concern or any appropriate escape-type self-contained breathing apparatus. [NIOSH: POCKET GUIDE TO CHEMICAL HAZARDS P. 75 (1987) DHEW (NIOSH) PUB NO. 85-114]

STORAGE

Protect against physical damage. Separate from combustible, organic or easily oxidizable materials and especially isolate from acetylene, ammonia, hydrogen, hydrocarbons, ether, turpentine, and finely divided metals. Store outdoors or in well-ventilated, detached or segregated areas of noncombustible construction. [NFPA, P. 49-28, 1986]